# Synopsis

# for

# Doctoral Degree Registration

# on

# A Generic Object Detection Approach for Advanced Driver Assistance System Applications


By

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# 1 Introduction

Advanced Driver Assistance System (ADAS) provides a significant role in Intelligent Transportation Systems (ITS). ADASs have a direct support interaction with the driver and has become the need of present and future generation automobiles. Now and in future there is a huge potential for systems which are capable of compensating for sight obstructions, guide the driver's attention to critical aspects, help to detect activity deficits, support the driver to keep safe distances to cars in front, as well as to avoid lane departure [1]. Many safety features are considered under an advanced driver assistance system such as blind spot detection, pedestrian detection, lane departure warning indication, cruise control, hazard recognition, collision avoidance, parking assistance, fatigue warning etc as shown in fig. 1.

Figure 1: Features of Advanced Driver Assistance System

Advanced driver assistance systems are being developed to automate/ adapt/ enhance vehicle systems for safety and better driving. Safety features are designed to avoid collisions and accidents by offering technologies that alert the driver to potential problems, or to avoid collisions by implementing safeguards and taking over control of the vehicle. ADAS relies on inputs from multiple data sources, including Automotive Imaging, LiDAR, Radar, Image Processing, Computer Vision.

# 2 Literature Survey

N. Dalal et al. [2] illustrates efficient pedestrian detection algorithm based on HOG and SVM for high detection accuracy to overcome time complexity issues. Authors presented two ways to increase the efficiency, One way was to reuse the features in the blocks to construct the HOG features for a detection window. Another way was to utilize sub-cell based interpolation to efficiently compute the HOG features for each block. The combination of the two ways resulted in significant increase in detecting humans. B. Wu et al. [3] considered part based detection for pedestrian identification that can handle occlusion effectively. The maximum joint likelihood approach utilizes part detection responses to classify the pedestrian from the other objects with the average detection rate around 92 % and computation time per frame as 2.5 seconds.

David Geronimo et al. [4] presented a strategy for comparative analysis of pedestrian detection algorithm on public benchmark dataset. The problem of detecting pedestrians from images was divided into three processing steps, foreground segmentation, object classification and verification/ refinement, each with attached responsibilities. A different approach based on contour templates was used by D Thanh Nguyen et al. [5] for object detection taking into consideration the shape and appearance of the objects under various illumination conditions. In 2013, Antonio Prioletti et al. presented state-of-the-art pedestrian detection system based on a two-stage classifier[6] . They extracted the candidates with a Haar cascade classifier trained with the Daimler Detection Benchmark data set and then validated through a part-based histogram-of-oriented gradient (HOG) classifier with the aim of lowering the number of false positives. The system offered high performance in terms of detection rate, false positives per hour, and frame rate. Vijay Gaikwad et al. proposed a technique for the identification of unwanted lane departure of a traveling vehicle on a road using piecewise linear stretching function (PLSF) and Hough Transform [1]. The proposed system could detect lane boundaries in the presence of several image artifacts, such as lighting changes, poor lane markings, and occlusions by a vehicle, and it was able to issue an accurate lane departure warning in a short time interval.

Jamin Koo et al. proposed robust stereo matching algorithm for advanced driver assistance system based on color and gradient information [7] which was robust to real world's illumination variations. Driver distraction detection using semi-supervised machine learning is proposed by Tianchi Liu [8] to classify two driver states: attentive and cognitively distracted. The analysis was based on drivers' eye and head movement data from real driving conditions. In 2015, Amin Zarshenas et al. proposed a fast depth estimation technique for real-time applications [9]. The proposed architecture employed spatial and temporal disparity prediction modules in order to decrease spatio -temporal redundancy. Simulation results show that the proposed method reduces the computational complexity by 68 % - 83 % while maintaining comparable detection performance with the full-search block matching algorithm used as a reference.

# 3 Motivation

Advanced Driver Assistance Systems rely on visual cues derived from camera sensors to interpret and recognize their environment. At the core, the visual perception and recognition problem can be formulated as an image-based multi-class object identification and classification problem [5]. Despite a lot of research, practically usable, intelligent, real-time, and dynamic object detection/recognition and tracking methods are still unavailable. The primary difficulty in developing a robust object detector and classifier is the amount of variation in images and videos.

Conventional ADAS majorly deals with detection of some objects and doing basic classification. But, future ADAS demands many more features to be incorporated which include:

- Differentiation of vehicle type eg. police car vs taxi, ambulance vs delivery truck
- Pedestrian detection
- Lane departure warning
- Traffic sign and traffic light detection

- Driver alertness monitor
- Blind spot detection
- Depth map generation

# 4 Identified Open Research Problems

- Recognition and discrimination of pedestrians from other objects like tree, pole etc.
- Detection of pedestrians irrespective of wide variations in pose and clothing appearance.
- Correct lane detection in case of poor lighting conditions, night time, occlusion or excessive degradation of lane markings.
- Distance measurement from other vehicles using single camera.
- Detection of traffic signs and traffic lights at a distance while driving and alerting the driver.

# 5 Problem Definition

A generic object detection approach for Advanced Driver Assistance System Applications

# 6 Methodology

A real time video will be captured from the camera mounted on the vehicle. Distinctive features like SIFT, SURF can be extracted in the training phase of classifier. Further pattern recognition techniques are to be applied for specific object detection and tracking. Pedestrian can be effectively tracked by improving the existing tracking algorithms. In-path and oblique distances of the objects from the vehicle will be calculated using single camera calibration techniques.

# 7 Social Impact

Driver impairment is the first cause of accidents. Based on a literature survey, about 90 % of all traffic accidents are to be attributed to human failure, for instance, through fatigue, inattention or drowsiness at the wheel. The purpose of Advanced Driver Assistance Systems is that driver error will be reduced or even eliminated, and efficiency in traffic and transport will be enhanced. The benefits of ADAS implementations are potentially considerable because of a significant decrease in human suffering, economical cost and pollution.

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